

Final Report RDT 98-002

Study of Missouri Subgrade Soils

Description

The 1986 AASHTO Pavement Design Guide introduced the use of resilient modulus to characterize subgrade properties for use in pavement design. To enhance the knowledge of subgrade moisture and resilient modulus characteristics of Missouri subgrade soils, test sites were established at 26 locations across the state. Subgrade moisture was monitored at all sites using a nuclear moisture gauge over periods of 16 to 22 months. At nine of these sites, Falling Weight Deflectometer (FWD) data were also gathered over periods of 16 to 17 months to permit the backcalculation of the subgrade resilient modulus. The effects of climatological conditions (precipitation and temperature), subgrade soil type and pavement type on subgrade moisture content and subgrade resilient modulus were examined with the intent of improving the selection of representative parameters for subgrade testing and pavement design.

Findings & Conclusions

- There was a poor correlation between initial nuclear moisture gauge readings and water content of samples obtained at the start of this study.

Samples of the subgrade materials were obtained along with the initial nuclear moisture gauge readings at the start of this study. Water content subsequently determined from these samples in the laboratory did not correlate well with the initial nuclear moisture gauge readings. Several factors are identified that may contribute to the poor correlation at a site. These include: the narrow range of initial water contents; accuracy and repeatability of laboratory testing and field measurements; and possible variations in soil chemistry and density. Because of this poor correlation, the initial and subsequent measurements obtained with the nuclear moisture gauge are presented in terms of count ratio rather than water content. This provides a relative measure rather than a quantitative measure of the differences in subgrade moisture with depth and time.

- No consistent trends of seasonal variation in subgrade moisture were observed.

The data indicated that the subgrade moisture does vary with time. The greatest variation was observed in the lower portion of the pavement structure and the upper portion of the subgrade and is attributed to wetting and drying caused by

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climatological factors (precipitation and temperature). However, the average subgrade moisture content beneath the pavement structure did not vary consistently or significantly enough to clearly identify seasonal trends. Possible reasons for this lack of consistent seasonal trends include the sporadic and irregular frequency of subgrade moisture monitoring and variations in seasonal climatological conditions from year to year during this study.

- Seasonal variations in subgrade resilient modulus were due largely to stress dependent behavior of the subgrade caused by variation in the stiffness (modulus) of the overlying pavement section.

The backcalculated values of subgrade resilient modulus varied significantly in spite of a lack of clear seasonal trends in subgrade moisture. The data indicates that variations in the resilient modulus of the generally fine-grained subgrades correspond to variations in the stiffness (modulus) of the overlying pavement section. This was most clearly noted in asphalt concrete pavements which experience significant change in modulus with temperature. However, this behavior was also noted for Portland cement concrete pavements and composite pavements.

- No evidence of increase in subgrade resilient modulus due to freezing of the subgrade was observed.

Climatological data indicate that this study was conducted over a milder than normal winter where the average monthly temperatures across the state remained at or above freezing. However, climatological data also indicate that average monthly temperatures in winter do extend below freezing for approximately the northern third of Missouri

Contact:

If you would like a copy of the full report, please contact Jim Radmacher with the Missouri Department of Transportation by telephone at 573-751-0852 or by email at radmaj@mail.modot.state.mo.us. Please refer to Report Number RDT 98-002.

If you would like further information on the details of this study, please contact Tom Fennessey with the Missouri Department of Transportation by telephone at 573-526-4340 or by email at fennet@mail.modot.state.mo.us.